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Prevalence of Drug Use in Commercial Tractor-Trailer Drivers

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ABSTRACT: An enforcement emphasis project, "Operation Trucker Check," was established in order to determine the extent to which commercial tractor-trailer drivers were operating their vehicles while impaired by drugs. A total of 1079 drivers and their vehicles were assessed for driver and equipment violations, and drivers additionally underwent preliminary field sobriety tests conducted by drug recognition expert (DRE) officers. Anonymous urine specimens for drug analysis were requested, and 822 urine specimens were obtained in total. Compliance with the drug-testing portion was voluntary, and there was a 19% refusal rate. Overall, 21% of the urine specimens tested positive for either illicit, prescription, and/or over-the-counter drugs, and 7% tested positive for more than one drug. Excluding caffeine and nicotine, the largest number of positive findings (9.5%) were for CNS stimulants, such as methamphetamine, amphetamine, phentermine, ephedrine/pseudoephedrine, and cocaine. The second most frequently encountered drug class were the cannabinoids, with 4.3% of drivers testing positive for marijuana metabolites. Only 11 drivers (1.3%) were positive for alcohol. Sixteen truck drivers (1.6%) were charged with driving under the influence of drugs after a full DRE evaluation was conducted. The results indicate that in spite of comprehensive drug testing in the trucking industry, some tractor-trailer drivers are continuing to take illicit and other drugs with the potential of having a negative effect on their driving ability. On the other hand, only a few drivers were, in fact, deemed to be under the influence of drugs at the time of driving when evaluated by DRE officers.

KEYWORDS: forensic science, toxicology, tractor-trailer drivers, driving impairment, drug recognition expert (DRE), drug use, stimulants

The number of commercial tractor-trailer drivers driving while impaired or driving with faulty truck equipment has been of interest due to the large number of crashes they are involved in, and the high number of fatalities associated with these crashes. It is usually the occupants of the other passenger vehicles involved in these crashes that are killed. In 1997, there were 5264 fatalities in the United States resulting from large truck crashes.[3] Fourteen percent of these fatalities were occupants of commercial trucks, while 75% were occupants of passenger vehicles. The remaining fatalities were pedestrians, bicyclists, and motorcyclists.

There is considerable informal information, primarily from surveys, which indicate that many commercial truck drivers use drugs to cope with the fatigue and boredom encountered during long driving hours. In a 1977 mail survey, 14% of male truck drivers reported regularly or occasionally using stimulants to stay awake while driving (1). In a 1989 survey, truck drivers believed that 26% of their colleagues regularly drove under the influence of illegal drugs (2). Other than self-reporting, there have been only two major studies evaluating the prevalence of drug use by commercial truck drivers.

In a study conducted in Tennessee in 1986, commercial truck drivers were randomly stopped and interviewed, and asked to provide voluntary blood and urine specimens (1). The study had a blood and/or urine sample refusal rate of 26%. Nevertheless, the authors found that 29% of the truck drivers were positive for drugs such as alcohol, marijuana, cocaine, and other stimulants. Cannabinoids were found in 15% of cases, over-the-counter (OTC) stimulants such as ephedrine, pseudoephedrine, and phenylpropanolamine in 12%, prescription stimulants such as methamphetamine and amphetamine in 5%, cocaine in 2%, and ethanol in less than 1%. The authors classified methamphetamine and amphetamine as prescription stimulants rather than drugs of abuse, as these substances may be found in various prescription medications for the treatment of attention deficit disorder, narcolepsy, and obesity.

In 1987 and 1988, an investigation of 168 fatally injured commercial truck drivers in 8 different states was conducted to determine the incidence of drug and/or alcohol use in truck crashes (2). The authors found 67% of the deceased drivers were positive for one or more drugs of abuse, prescription drugs or OTC medications. Thirty-three percent of the drivers were positive for psychoactive drugs such as ethanol (13%), cannabinoids (13%), cocaine or benzoylecgonine (8%), amphetamine and/or methamphetamine (7%), OTC stimulants such as ephedrine and pseudoephedrine (7%), or a combination of these. The authors concluded that although impairment due to substance use contributed to some of the crashes, multiple factors probably contributed to most: factors such as drug use, driver fatigue, driver inexperience, mechanical failures, load shifts, and environmental conditions.

In southern Oregon in 1997 and 1998, six commercial truck drivers were arrested for driving under the influence of drugs (DUID), and tested positive for central nervous system (CNS) stimulants.[4] During January to October 1998, 70 commercial truck crashes occurred in southern Oregon alone, resulting in two fatalities and several serious injuries. Two particular truck crashes in Oregon gained public attention. In the first crash, a gasoline tanker veered off the roadway and exploded into flames, killing the driver.

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[3] Captain Charles E. Hayes: Personal communication; June 1999.

[4] Captain Charles E. Hayes: Personal communication; October 1999.

The driver tested positive for alcohol, methamphetamine, cocaine and marijuana. In the second crash, a truck driver crossed the centerline and crashed into an oncoming passenger vehicle, killing the two occupants. The driver tested positive for methamphetamine and marijuana.

As a result, the Oregon State Police, the Oregon Department of Transportation, and various other allied agencies established "Operation Trucker Check" in October 1998 to check for driver and equipment violations, and to investigate the prevalence of drug use in truck drivers. Due to its success, the study was repeated in September 1999, in collaboration with the Washington State Patrol. The results of these two separate inspections are presented in this paper.

Methods

Both phases of "Operation Trucker Check" were unannounced inspections of commercial truck drivers and their vehicles (tractor-trailer and single-unit trucks) for a continuous 48 h. Truck drivers were randomly selected, on a next-available inspection basis, at various sites. Operation Trucker Check I was conducted in October 1998 in Oregon. Two northbound port-of-entry inspection sites were chosen near the Oregon-California state line. A 48-h continuous inspection was conducted on Interstate 5 at Ashland, OR, and two 8-h inspections were conducted on U.S. Highway 97 at Klamath Falls, OR. Operation Trucker Check II was conducted in September 1999 in Oregon and Washington. Three port-of-entry inspection sites were chosen near the Oregon-Washington state line. In Washington, two 48-h continuous inspections were conducted on northbound Interstate 5 (north of Vancouver, WA) and eastbound on State Route 14 (near Stevenson, WA). In Oregon, a 48-h simultaneous inspection was conducted on eastbound Interstate 84 at Cascade Locks.

A commercial vehicle enforcement officer inspected each vehicle, and an experienced drug recognition expert (DRE) officer made a preliminary subjective assessment of each driver for signs of impairment, whether resulting from drug and/or alcohol use, driver fatigue, or a medical condition. Additionally, in Operation Trucker Check II, drug detection dogs were used to conduct vehicle and cargo inspections for the presence of illegal drugs. The DRE officer conducted a preliminary evaluation, which consisted of horizontal and vertical gaze nystagmus, lack of convergence, pupil size, and the Romberg balance (with 30-s clock) test. Each driver preliminarily evaluated by a DRE officer was asked to provide an anonymous and voluntary urine specimen for study purposes only. A waiver was provided for each driver to sign, indicating that results could not be used for criminal or civil proceedings against the driver and/or their company. All voluntary urine specimens were submitted to the Washington State Toxicology Laboratory for testing.

If impairment was observed or suspected, the driver underwent a full DRE evaluation (3), and was formally charged with DUI if impairment was found. For truck drivers arrested in Washington state, a blood specimen was taken and submitted to the Washington State Toxicology Laboratory for comprehensive drug analyses; for truck drivers arrested in Oregon, a urine specimen was taken and submitted to the Oregon State Police Forensic Laboratory and underwent an immunoassay screen for controlled substances. A full comprehensive drug screen using gas chromatography-mass spectrometry (GCMS) was performed only if the initial immunoassay screen produced a presumptive positive.

Toxicological Testing

All voluntary urine specimens were submitted to the Washington State Toxicology Laboratory, and were tested for alcohol, and screened for drugs by immunoassay and GCMS techniques.[5] For alcohol analysis, urine specimens (0.2 mL) were mixed with internal standard (2 mL of 0.15 mL *n*-propanol/1L deionized water/10 g sodium chloride solution), and injected on a headspace GC with flame ionization detection (GCFID). Urine specimens (300 μL) were assayed by Enzyme Multiplied Immunoassay Technique (EMIT), (SYVA) using a Cobas Mira autoanalyzer. The EMIT procedure screened for cocaine metabolites (cutoff limit 150 ng/mL), opiates (300 ng/mL), amphetamines (1000 ng/mL), carboxy-tetrahydrocannabinols (20 ng/mL), methadone (300 ng/mL), phencyclidine (25 ng/mL), propoxyphene (300 ng/mL), barbiturates (200 ng/mL), benzodiazepines (200 ng/mL), and tricyclic antidepressants (300 ng/mL).

Urine specimens were also extracted prior to analysis by gas chromatography with nitrogen/phosphorus detection (GCNPD) and gas chromatography/mass spectrometry (GCMS) (Hewlett Packard/Agilent). Urine (1 mL), internal standard (metycaine, 50 μL of a 10 mg/L solution in ethyl acetate), and pH 9 saturated potassium borate buffer (1 mL) were mixed, and extracted with *n*-butyl chloride (3 mL). The organic fraction was back extracted into 3 M hydrochloric acid (200 μL), which was then made alkaline with concentrated ammonium hydroxide/ammonium carbonate and re-extracted into chloroform (100 μL), containing the chromatographic standard diphenylamine (2 mg/L solution). A 2 μL aliquot of the chloroform fraction was then injected for analysis. Carboxy-tetrahydrocannabinol (carboxy-THC) was also confirmed by GCMS with a cut-off of 5 ng/mL.

Results

During Operation Trucker Check I, commercial vehicle enforcement officers inspected a total of 446 tractor-trailer trucks and their drivers (Table 1). One hundred and eight (24%) were placed out of service due to vehicle and/or driver violations. The majority of

TABLE 1—*Vehicle and driver inspection results: Operation Trucker Check I and II.*

	Check I	Check II	Total
Vehicles inspected	446	633	1079
Drivers inspected	393	633	1026
Vehicles/drivers placed out of service	108 (24%)	118 (19%)	226 (21%)
Preliminary DRE evaluations	393	633	1026
Full DRE evaluations	10	15	25
Arrested for driving under the influence of drugs*	6 (1.5%)	10 (1.6%)	16 (1.6%)
Voluntary urine specimens submitted†	367	469	836
Refusal to submit voluntary urine specimen	26 (7%)	164 (26%)	190 (19%)
Voluntary urine specimens analyzed	361	461	822

DRE—Drug Recognition Expert.
* Percentage of total drivers evaluated by a DRE.
† Includes urines that were not suitable for analysis.

[5] The specimens originating from Operation Trucker Check I were additionally subjected to limited immunoassay drug testing by the Oregon State Police Forensic Laboratory in Springfield, OR. The results of those tests, not presented here, were generally consistent with the findings from our laboratory, although several immunoassay amphetamine positive results appeared to be due to over-the-counter phenethylamines when confirmed using GCMS techniques by the Washington State Toxicology Laboratory.

these were due to equipment violations such as inadequate brakes and defective tires. Driver violations included failure to maintain a logbook, driving for excessive hours, and driving without a valid commercial drivers license. DRE officers conducted a preliminary evaluation on a total of 393 of the 446 truck drivers (88%). Ten truck drivers subsequently underwent full DRE evaluations: six were arrested for DUID and four drivers were deemed to be suffering from fatigue. In total, 361 urine samples were voluntarily submitted for analysis; 26 drivers (7%) refused to submit a urine specimen, and six urines were inadequate for testing.

During Operation Trucker Check II, 633 drivers and their vehicles were inspected. One hundred and eighteen (19%) were placed out of service due to vehicle and/or driver violations for similar reasons to those mentioned for Operation Trucker Check I. All 633 drivers underwent preliminary DRE evaluations. Fifteen drivers underwent full DRE evaluations and ten drivers were subsequently arrested for DUID. In total, 461 urine specimens were voluntarily submitted for analysis; 164 drivers (26%) refused to submit a urine specimen, and eight urines were inadequate for testing.

Over both operations, the compliance rate with the request for a voluntary urine sample was 80%, with 19% refusing, and 1% unsuitable for analysis, due to leaks or inadequate volume.

In the 16 subjects arrested for DUID during Operation Trucker Checks I and II, seven were suspected of driving under the influence of a CNS stimulant, two under the influence of a narcotic analgesic, two under the influence of alcohol, one under the influence of marijuana, two under the combined influence of a CNS stimulant and marijuana, one under the combined influence of a CNS stimulant and a narcotic analgesic, and one under the combined influence of marijuana and a narcotic analgesic (Table 2).

TABLE 2—*Circumstances, DRE opinion, and toxicology results of the 16 truck drivers arrested for driving under the influence of drugs.*

Case #	DRE opinion	Circumstances	Specimen	Toxicology Results
1	CNS stimulant and Narcotic analgesic	Constricted pupils, body tremors, poor coordination, flaccid muscle tone, slowed movements. Admitted to Vicodin (hydrocodone) use. In possession of Darvocet (propoxyphene) and Vicodin	Urine	Hydrocodone
2	CNS stimulant	Poor coordination, elevated pulse, elevated blood pressure, body tremors, fast internal clock	Urine	Immunoassay screen negative
3	CNS stimulant and Cannabis	Elevated pulse, poor balance and coordination, fast internal clock (19 s), nasal area red, rapid speech	Urine	Immunoassay screen negative
4	CNS stimulant	Poor balance during SFST's, elevated pulse (122–155 bpm), elevated blood pressure (186/112 mmHg), nervous acting, overly anxious	Urine	Ephedrine
5	CNS stimulant	Poor coordination, fast and jerky body movements, elevated pulse	Urine	Immunoassay screen negative
6	CNS stimulant	Restless, anxious, eyelid tremors, slow internal clock (54 s), bruxism, poor balance and coordination during SFST's, dilated pupils, elevated pulse	Urine	Immunoassay screen negative
7	Narcotic analgesic and Cannabis	Odor of marijuana on person, glassy eyes, slow raspy speech, eyelid tremors, fast internal clock, elevated pulse, unable to follow instruction, poor balance on walk and turn test, rebound dilation. Admitted to smoking marijuana earlier in day, and in possession of marijuana	Urine	Immunoassay screen negative (Cannabinoids below 20 ng/mL cutoff)
8	Narcotic analgesic	Slow movements, poor balance and coordination, constricted pupils and slow internal clock. Admitted to using two different prescription opiates for back injury	Urine	Methamphetamine, amphetamine, propoxyphene, codeine, hydrocodone
9	Cannabis	Dilated pupils, elevated pulse, body tremors, poor balance on SFST's	Urine	Cannabinoids positive
10	CNS stimulant	Elevated pulse, dilated pupils, poor balance on one leg stand, poor coordination of finger to nose, body tremors. Claimed he was suffering from "mental problems"	Refused urine collection	No testing performed
11	CNS stimulant and Cannabis	Dilated pupils, elevated blood pressure, fidgety, restless, fast speech, poor balance and coordination during SFST's, muscle rigidity. Admitted using "Mega Ginseng Energy Blast" which was located in vehicle. Also found in possession of marijuana	Refused urine collection	No testing performed
12	CNS stimulant	Jittery, perspiring, and rapid speech. Found in possession of methamphetamine. Taking Zantac	Blood	Caffeine, Nicotine
13	CNS stimulant	Poor coordination, perspiring, rapid speech, elevated pulse (128–138 bpm), elevated blood pressure (184/94 mmHg), temperature 99°F, slow reaction to light, nervous, body tremors, hand twitching, white substance in nostril	Blood	Caffeine
14	Narcotic analgesic	Constricted pupils, body tremors, drowsiness, little reaction to light, pulse 62–68 bpm, blood pressure 150/100 mmHg, temperature 98°F. Taking Motrin and Tylenol	Blood	Caffeine
15	Ethanol	Arrested	Breath	Ethanol
16	Ethanol	Arrested	Breath	Ethanol

DRE—Drug Recognition Expert; CNS—Central nervous system; SFST's—Standardized field sobriety tests.

Note: Cases #1–9—Urine samples from these arrested drivers were sent to a forensic laboratory in Oregon, and only underwent an immunoassay screen (EMIT) for drugs of abuse. Only those urines which screened positive by EMIT underwent further screening and confirmation for other illicit, prescription, and OTC drugs by GCMS.

Note: Cases #15 and 16—Arrested for general DUI-alcohol arrest and/or commercial vehicle arrest ($\geq$0.04 breath alcohol concentration).

TABLE 3—*Ethanol, drugs of abuse and other frequently detected drugs: Operation Trucker Check I and II.*

Drug/Class	Truck Check I (N = 361)	Truck Check II (N = 461)	Total (I and II) (N = 822)
Ethanol	1	10	11 (1.3%)
Carboxy-tetrahydrocannabinol	12	23	35 (4.3%)
CNS stimulants (total*)	11	14	25 (3.0%)
Methamphetamine/ amphetamine	5	9	14
Cocaine/benzoylecgonine	4	5	9
Phentermine	2	2	4
Phenmetrazine	2	2	4
Cocaethylene	1	1	2
OTC stimulants			
Ephedrine/pseudoephedrine	20	31	51 (6.2%)
Opiates/opioids (total*)	8	5	13 (1.6%)
Codeine	4	1	5
Hydrocodone	4	1	5
Propoxyphene	1	1	2
Morphine	1	1	2
Oxycodone	0	1	1
Methadone	0	1	1
Phencyclidine	0	1	1
Antihistamines (total*)	19	18	37 (4.5%)
Chlorpheniramine	9	9	18
Diphenhydramine	5	9	14
Doxylamine	5	3	8
Brompheniramine	0	1	1
Pheniramine	1	0	1
Caffeine	337	434	771 (94%)
Nicotine	189	274	463 (56%)

CNS—Central nervous system; OTC—Over-the-counter. (Total*)—Total number of urine specimens positive for this drug class (NB: some drivers were positive for more than one drug in a particular drug class).

Overall, 1026 drivers were evaluated, and 822 urines were submitted for drug analysis from both inspections. Tables 3 and 4 show the overall results following the analysis of the urine specimens. Cannabinoids, methamphetamine/amphetamine, and ethanol were the most commonly detected drugs of abuse, occurring in 4.3%, 1.7%, and 1.3% of cases, respectively. While ethanol is not an illegal substance, the Federal Department of Transportation has passed rules stating that truck drivers shall be temporarily suspended from driving if their blood alcohol concentration is between 0.01–0.04 g/100 mL. If their blood alcohol concentration is 0.04 g/100 mL or greater, their commercial drivers license will be revoked and they can be charged with driving under influence (2). The alcohol concentrations in the urine samples were: 0.01, 0.01, 0.02, 0.02, 0.02, 0.02, 0.03, 0.04, 0.04, 0.06 and 0.10 g/100 mL (range 0.01 to 0.10 g/100 mL; mean 0.04 g/100 mL and median 0.02 g/100 mL).

The largest number of positive urine results in the 822 drivers in this study was for CNS stimulants. Approximately 2.5% of all urine specimens were positive for illicit or prescribed stimulants such as methamphetamine, amphetamine, phenmetrazine and phentermine, and 1% were positive for cocaine. In the 14 cases positive for methamphetamine, 12 were also positive for amphetamine. Other centrally acting stimulants such as ephedrine/pseudoephedrine, commonly found in OTC medications sold at truck stops and gas stations, were found in 6.2% of urine specimens analyzed. Caffeine, a mild centrally acting stimulant, was present in 94% of truck drivers tested.

Less than 2% of urine specimens were positive for opiates, specifically codeine and hydrocodone, which are present in a variety of prescription medications. Codeine is available over the counter in Canada. The most frequently detected therapeutic medications included the sedative antihistamines chlorpheniramine, diphenhydramine, and doxylamine. Other miscellaneous therapeutic drugs detected included diazepam, amitriptyline, bupropion, dextromethorphan, guaiphenesin, and thioridazine (Tables 3 and 4).

Overall, of the 822 urines analyzed for drugs, 171 (21%) were positive for at least one illicit, prescription and/or OTC drugs, while 59 (7%) were positive for more than one drug (Table 5). Alcohol and/or drugs or abuse (amphetamines, marijuana, cocaine, phencyclidine) were detected in 78 (9%) of urine specimens overall.

Discussion

Twenty-one percent of vehicles during Operation Trucker Check I and II were placed out-of-service due to driver and equipment vi-

TABLE 4—*Less frequently detected prescription and over-the-counter drugs: Operation Trucker Check I and II.*

Drug / Class	Truck Check I (N = 361)	Truck Check II (N = 461)	Total (I and II) (N = 822)
Benzodiazepines			
Diazepam	0	3	3
Temazepam	0	1	1
Antidepressants			
Amitriptyline	0	3	3
Bupropion	0	3	3
Sertraline	2	0	2
Citalopram	0	1	1
Doxepin	0	1	1
Fluoxetine	1	0	1
Venlafaxine	0	1	1
Miscellaneous prescription drugs			
Diltiazem	3	1	4
Lidocaine	2	2	4
Levorphanol	2	1	3
Thioridazine	3	0	3
Trimethoprim	1	2	3
Metoprolol	0	2	2
Cyclobenzaprine	0	1	1
Dapsone	0	1	1
Ethosuximide	0	1	1
Fluconazole	1	0	1
Haloperidol	0	1	1
Nevirapine	0	1	1
Orphenadrine	0	1	1
Ropivacaine	0	1	1
Quinine/Quinidine	1	0	1
Miscellaneous OTC Drugs			
Guaiphenesin	4	2	6
Dextromethorphan	3	2	5

OTC—Over-the-counter.

TABLE 5—*Overview of results: Operation Trucker Check I and II.*

	Truck Check I (N = 361)	Truck Check II (N = 461)	Total (I and II) (N = 822)
At least one drug*	19%	22%	21%
More than one drug*	7%	8%	7%
Alcohol and/or drugs of abuse	7%	11%	9%

* Illicit, prescription or over-the-counter drugs.

olations. Crouch et al., 1993 proposed that multiple factors, in addition to any alcohol or drug induced impairment, were causal in the majority of large truck crashes. They listed driver fatigue and inexperience, medical problems, failure to heed warning signs, mechanical problems, and load shifts as examples of contributory factors. The majority of the violations cited in the present study included inadequate brakes, defective tires, and driving for excessive hours, which supports the views of Crouch et al., (2) that factors other than impairment due to alcohol and drugs may play a major underlying role in tractor-trailer crashes.

The largest numbers of positive results were for CNS stimulants, which is not surprising as both illicit and prescribed forms of these drugs are often used to overcome fatigue. Illicit stimulants, such as methamphetamine and cocaine, reduce fatigue and drowsiness and increase alertness, however, they also cause restlessness and agitation, diminish a driver's ability to focus attention on divided attention tasks, and increase a driver's willingness to take increased risks (4,5). Ephedrine and pseudoephedrine are commonly found in OTC medications such as Primatene®, Quadrinal® and Sudafed®, and are generally used as cold and allergy remedies, nasal decongestants, bronchodilators, and weight-loss products. Ephedrine and pseudoephedrine also have mild central stimulant effects and are used by drivers to help them stay awake during long hours of driving. Caffeine, a mild centrally acting stimulant, was present in the vast majority of truck drivers tested. Since testing was performed only on urine samples, it was unknown whether any of the drivers had consumed excessive quantities of caffeine to stay awake during driving, or whether they had been prescribed caffeine tablets for the same purpose.

The most frequently detected antihistamines were chlorpheniramine (Chlor-Trimeton®), diphenhydramine (Benadryl®, Actifed®), and doxylamine (Nyquil®). These first generation antihistamines can pass through the blood brain barrier and cause marked sedation and drowsiness, altered mood, reduced wakefulness, and impaired cognitive and psychomotor performance (6–9). Diphenhydramine has significant adverse effects on vigilance, divided attention, working memory, and psychomotor performance. Impairment has been shown to occur even in the absence of self-reported sleepiness. In contrast, the second-generation antihistamines such as loratadine (Claritin®) do not readily cross the blood brain barrier, and are non-sedating at recommended doses.

Nine percent of the truck drivers tested had either alcohol and/or illicit drugs present in their urine specimens. One truck driver was positive for cannabinoids, cocaine, methamphetamine, and amphetamine, while another driver tested positive for cannabinoids, cocaine, and ephedrine. Cannabinoids, propoxyphene, ephedrine, and fluoxetine were detected in the urine of yet another truck driver. Furthermore, there were several additional cases positive for both cannabinoids and methamphetamine. Of the 14 cases positive for methamphetamine, 12 were also positive for amphetamine.

Comparing the results from the present study to those of Lund et al., 1988 and Crouch et al., 1993, it would appear that fewer commercial truck drivers in the present study were positive for drugs overall (Table 6). This is despite a similar rate of refusal in providing a specimen been observed between the present study (19% refused) and Lund et al., 1988 (26%). For example, only 4.3% of the current cases were positive for cannabinoids, compared to between 13–15% from the previous two studies. CNS stimulants, including illicit, prescription and OTC stimulants, were found in 9.5% of the current cases, compared to 19% (1) and 23% (2). One likely contributing factor in the apparent decrease is that since these earlier two studies were reported in the mid-late 1980's, employee drug testing within the trucking industry has become mandatory, and the incidence of drug use has most likely declined.

TABLE 6—*Comparison of present and previous studies for percentage of drivers positive for various illicit, prescription and over-the-counter medications.*

Drug/Drug Class	Present Study (N = 822)	Lund et al., 1988 (N = 317)	Crouch et al., 1993 (N = 168)
Cannabinoids	4.3%	15%	13%
Ethanol	1.3%	< 1%	13%
Stimulants–prescription*	2.3%	5%	8%
Stimulants–OTC†	6.2%	12%	7%
Cocaine/benzoylecgonine	1.0%	2%	8%
Opiates	1.7%	0	< 1%
Other prescription/OTC	9.0%	< 1%	< 1%

* Includes methamphetamine, amphetamine, phentermine, and phenmetrazine.

† Includes ephedrine and pseudoephedrine; caffeine not included.

OTC—Over-the-counter.

The evidence of rates of alcohol use in these drivers was disturbing, even though the concentrations were low at the time of sampling. Urine to blood alcohol conversion is difficult at the best of times—even when testing a sample collected after a urinary void, which did not occur in this case. As a result, any conversion from urine to blood may overestimate the actual blood alcohol concentration at the time of the sampling. On the other hand, it is impossible to assess how many of the drivers testing positive for alcohol had been driving at some earlier time with higher blood alcohol concentrations. Understanding these limitations, and using a urine to blood alcohol conversion ratio of 1.2:1, only one of the 822 drivers providing a urine sample was above the per se blood alcohol limit in both Washington and Oregon of 0.08 g/100 mL. Only two were above the Department of Transportation threshold for per se illegal operation of a commercial vehicle of 0.04 g/100mL, although the remaining drivers, if detected, would have been removed from the road, until their blood alcohol had returned to zero. Given the documented effects on coordination, reaction time, and psychomotor skills even at low blood alcohol concentrations, and the high demands on operators of large, heavy vehicles with poor maneuverability (many of which were found to be in poor operating condition), the use of any alcohol proximate to driving is a cause for concern for all road users.

It is also interesting to compare the present study to one conducted in 1996, which studied a similar geographic area. Logan and Schwilke reported on patterns of drug use in fatally injured drivers in Washington State between 1992 and 1993 (10). Drugs most commonly encountered were ethanol (46%), marijuana (11%), cocaine (3%), amphetamine (2%), and a variety of depressant prescription medications. In the present study, a similar percentage of illicit and/or prescription stimulants were found, however, a lower frequency of ethanol and marijuana use was noted, and a higher use of OTC stimulants, sedative antihistamines, and miscellaneous prescription and OTC medications was observed.

There are several limitations in the design of the present study. Firstly, 19% of the tractor-trailer drivers refused to provide a voluntary urine specimen. While the distribution of drugs in this subgroup is unknown, drivers using drugs would have the greatest motivation to refuse, in spite of assurances that the sampling was anonymous and would not be used in civil or criminal proceedings

against them. Secondly, there appeared to be excellent lines of communication between truck drivers, allowing drivers the opportunity to park and avoid the inspection, or to change drivers if a second or co-driver was available. In both inspections, numerous trucks were observed parked at various locations along the highway prior to the inspection points, raising concern that drivers may be purposely trying to avoid the inspection process due to driver or equipment violations, or may have been impaired if evaluated by a DRE. Again, the distribution of drugs in this group is unknown. Thirdly, by analyzing urine, one is unable to determine the time of drug ingestion and whether the driver was actually impaired at the time of driving. Due to the fact that both phases of Operation Trucker Check were stationary inspections, very little driving by the truck drivers was observed by the DRE's.

It is important to note that only 1.6% of the 1026 truck drivers tested in the present study were deemed to be impaired by drugs when they were evaluated by experienced DRE officers. The failure of DRE's to identify all the urine positive cases suggests that the DRE exam has an appropriate level of sensitivity in that it is truly detecting impairment and not simply historical drug use. Conversely, there were several cases where the DRE officer observed signs of impairment, usually due to CNS stimulants, and no drugs were detected following analysis by EMIT and/or GC-EIMS.

Case #8 (Table 2) is an example of an arrested truck driver whose drug use was confirmed by toxicology results. This Oregon driver was contacted during the inspection after demonstrating confusion while entering the inspection site. A preliminary exam showed very poor balance and slowed, lethargic movements. The driver also had constricted pupils and a slow internal clock. The full DRE evaluation determined that the driver was under the influence of a narcotic analgesic. The driver admitted to using two different prescription opiates for a back injury (oxycodone and codeine). An inspection of the prescription bottles determined that the driver had exceeded the recommended dosages of both. Hydrocodone, codeine, propoxyphene, and trace amounts of methamphetamine and amphetamine were detected in the driver's blood. However, in another driver (Case #6) the DRE officer suspected that the driver was under the influence of a stimulant due to the driver exhibiting restlessness, anxiousness, eyelid tremors, bruxism, dilated pupils, elevated pulse, and poor performance during the SFST's. Since this case occurred in Oregon, only urine was collected and no comprehensive chromatographic screening was performed. No stimulant drugs were detected in the screen of the driver's urine specimen. One explanation for this is that the urine underwent only an immunoassay screen (EMIT) for controlled substances. A full comprehensive drug screen using GCMS was performed only if the initial immunoassay screen produced a presumptive positive. Using this approach, low levels of several stimulants such as pseudoephedrine, ephedrine, phenylpropanolamine, and MDMA, may not be detected. There is also a possibility that the subject administered another CNS stimulant, which was undetectable by the screening methodology used, or that the substance fell below the screening cut-off level for that drug or drug class. Nonetheless, regardless of the actual cause of the demonstrable impairment in these 16 drivers, they were safely removed from the road as a result of the DRE officer's evaluation.

In conclusion, it has been shown that some commercial truck drivers continue to use illicit, prescription, and OTC drugs, albeit at lower rates than in the late 1980's. This is in spite of widespread mandatory drug testing in the trucking industry. Although many of these drugs have the potential to negatively affect driving performance, the mere presence of these drugs in urine does not indicate impairment. In fact, only 1.6% of all truck drivers evaluated by a DRE officer were charged with driving under the influence of drugs. Furthermore, since 24% of drivers and their vehicles were placed out of service during this study because of fatigue, mechanical or equipment problems, or rules violations, it is a likely indicator that multiple factors contribute to truck crashes, of which drug and alcohol use may be but one. In looking at the pharmacological class of the drugs showing up in these drivers, it is evident that truck drivers still want to stay awake beyond their natural inclination to do so, and look to over-the-counter as well as illicit stimulants to do so. Given the wide range of substances present, together with the known cross-reactivity particularly of the amphetamine assays with legitimate phenethylamine sympathomimetics reinforces that comprehensive drug screening, rather than immunoassay alone is necessary for detecting relevant drugs in drivers. The disparity between the urine positive results, and the presence of observable impairment by trained DRE officers, also suggests that blood would be a preferred specimen for relating toxicological findings to probable effects.

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References

1. Lund AK, Preusser DF, Blomberg RD, Williams AF. Drug use by tractor-trailer drivers. J Forensic Sci 1988;33(3):648–61.
2. Crouch DJ, Birky MM, Gust SW, Rollins DE, Walsh JM, Moulden JV. The prevalence of drugs and alcohol in fatally injured truck drivers. J Forensic Sci 1993;38(6):1342–53.
3. Drug Evaluation and Classification Training Program–The Drug Recognition Expert School. U.S. Department of Transportation, Transportation Safety Institute, National Highway Traffic Safety Administration. 1999 Edition.
4. Hurst PM. Amphetamines and driving. Alcohol, Drugs and Driving 1987;3(1):13–5.
5. Logan BK. Methamphetamine and driving impairment. J Forensic Sci 1996;41(3):457–64.
6. Witek TJ Jr, Canestrari DA, Miller RD, Yang JY, Riker DK. Characterization of daytime sleepiness and psychomotor performance following H1 receptor antagonists. Allergy Asthma Immunol 1995;74(5):419–26.
7. O'Hanlon JF, Ramaekers JG. Antihistamine effects on actual driving performance in a standard test: a summary of Dutch experience, 1989–94. Allergy 1995;50:234–42.
8. Gengo F, Gabos C, Miller JK. The pharmacodynamics of diphenhydramine-induced drowsiness and changes in mental performances. Clin Pharmacol Ther 1989;45:15–21.
9. Moskowitz H, Burns M. Effects of terfenadine, diphenhydramine, and placebo on skills performance. Cutis 1988;42(4A):14–8.
10. Logan BK, Schwilke EW. Technical note: Drug and alcohol use in fatally injured drivers in Washington state. J Forensic Sci 1996;41(3):311–6.

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